TWO-PIECE PISTON WITH COOLING PROVISIONS

Alexander Dreisl, Olympia Fields, Ill., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Filed July 28, 1967; Serial No. 656,731

3,424,138

Patented Jan. 28, 1969

ABSTRACT OF THE DISCLOSURE

An internal combustion engine piston having a crown section received within a skirt section and fastened therein by a lock resiliently biasing the crown section in the skirt section to permit axial expansion, the crown section being constructed of aluminum and the skirt section of cast iron. Cooling passages from the wrist pin connect with helical passages received in the crown section and the skirt section in the area of the piston rings to dissipate heat from the peripheral walls of the piston.

This invention relates to a piston and more particularly to a fluid cooled piston having improved thermal conductivity characteristics.

Increasing demands for greater power output are constantly being made upon the internal combustion engine. The increased power output requires higher speeds, higher pressures due to turbocharging and greater dissipation of the heat generated in the internal combustion chamber and transferred to the components defining the combustion chamber. The cooling accomplished through the water jacket in the cylinder provides adequate cooling up to a certain point. The water jacket does not adequately cool the piston which is subjected to greater heat and greater expansion and contraction stresses due to the differential temperatures on the piston itself. The increased speed of the internal combustion engine to gain greater output also places greater inertia stresses on the engine. Accordingly, this invention will overcome some of the deficiencies of the conventional internal combustion engine by providing a piston having greater thermal conductivity in the piston itself and also providing a means of dissipating the heat through a cooling means by circulating hydraulic fluid such as lubricating oil in the piston per se. The skirt section for the piston limits the peripheral expansion of the piston to operate within safe limits and prevent mechanical failure or seizure of the cylinder walls.

It is an object of this invention to provide a fluid cooled two-piece piston.

It is another object of this invention to provide a two-piece piston having a higher rate of heat transfer and an improved method of dissipating heat from the piston per se.

It is a further object of this invention to provide a two-piece piston having improved cooling in the ring area to reduce scuffing and extend piston and cylinder life.

It is a further object of this invention to provide a two-piece piston of bimetallic construction with a crown section of high thermal conductivity and a skirt section of low coefficient of expansion to maintain operating tolerances.

The objects of this invention are accomplished by providing a piston having a crown section received within the skirt section and fastened by means of a lock resiliently biasing the crown portion within the skirt section. The crown section is constructed of light weight metal to reduce inertia forces and receives within the skirt section to permit limited radial expansion although it has a high coefficient of expansion. The skirt section is constructed of a metal having a lower coefficient of expansion to maintain tolerances between the external periphery of the piston and the internal periphery of the cylinder within which the piston operates. Cooling passages are placed in the ring area of the piston to reduce the operating temperature of the piston in the ring area.

The preferred embodiment of this invention will be illustrated and described in the following paragraphs and in the attached drawings.

FIG. 1 illustrates a cross section view of the piston within a cylinder attached to a suitable connecting rod. FIG. 2 illustrates a cross section view of the piston within the cylinder taken at right angles to FIG. 1.

FIG. 3 is a fragmentary section view illustrating a locking means between the skirt and the crown sections.

FIG. 4 is a fragmentary cross section view showing the helical cooling grooves and the ring groove sealing construction of the piston.

FIG. 5 illustrates the cross section view taken along line V-V as shown in FIG. 2.

FIG. 6 is a view in elevation illustrating a segment of the crown section of the piston.

Referring to the drawings, the crown section 1 is received within the skirt section 2 which are locked together by a fastening means 3. The piston 4 is received within the cylinder 5 and reciprocally operates within the cylinder when the engine is operating.

The connecting rod 6 is connected to a suitable crankshaft and is fastened to the wrist pin 7. The wrist pin 7 is received within the transverse bore 8 of the piston 4. An oil passage 9 extends longitudinally within the rod 6 which in turn is connected to a radial passage 10 formed in the wrist pin 7. An annular recess 11 is formed within the piston rod 6 to provide lubrication between the wrist pin 7 and the rod 6. The wrist pin 7 is hollow and defines an opening 12 which extends the length of the wrist pin 7.

The crown section 1 and the skirt section 2 are constructed in such a manner that the adjoining walls of these two sections form a pair of annular recesses 13 and 14 which are in communication with the axial bore 12 of the wrist pin 7.

Referring to FIG. 1, the annular recess 13 is connected to a plurality of passages 15 which are skewed relative to the longitudinal axis of the piston 4. The radial passages 16 extend to the outer periphery of the crown section 1 and are in communication with the helical grooves 17. The helical grooves are more clearly shown in FIG. 6 in which a portion of the crown section is shown.

The helical grooves 17 are two in number and have a pitch of one half the lead of each groove. The helical grooves extend around the external periphery of the crown section 1 and end at a point upwardly from the passages 16 in an annular recess 18. The annular recess 18 is connected with the passages 19 which extend generally radially inward to form an acute angle with a diametrical line.

The passages 19 extend into a bell shaped opening 21 within the crown section 1. The connecting rod 6 is received within the bell shaped opening and is fastened to the wrist pin 7. The oil flowing inwardly in the passages 19 sprays onto the connecting rod 6 and cools the connecting rod and bearing structure and inner walls of the crown section 1 as it returns to the oil pan which is beneath the bank of cylinders in the internal combustion engine.

The walls adjoining the crown section 1 and the skirt 2 immediately below the radial passages 16 are provided with a sealing structure. This sealing structure comprises three annular grooves 22 of which the upper and lower receive O-rings to form a seal between the helical grooves 17 and the annular recesses 13 and 14. The intermediate groove of the O-ring grooves is connected to the passage 23 which extends radially to the oil ring groove 24. The oil ring 25 and groove is constructed in a manner whereby oil wiped from the cylinder wall may enter the oil groove.
The crown section 1 of the piston is formed of a reduced diameter 25 in extreme upper end which receives the annular shoulder 26 formed on the extreme upper end of the skirt section of the piston. A longitudinal slit 27 receives a pin 28 to maintain the two sections in a non-rotating position relative to each other.

The extreme upper end of the crown section 1 also forms the combustion chamber 29 which is in direct contact with the combustion products in the internal combustion engine. The peripheral wall of the upper portion of the skirt section 2 is also formed with three annular ring grooves 30 which receive compression rings 53 to maintain compression within the combustion chamber 29.

Referring to the lower portion of the crown section and the skirt section, a locking means 3 is provided to maintain the axial relationship of these two sections. Means is also provided to accommodate for the greater expansion of the crown section which is formed of an alloy or a metal such as aluminum which has a greater coefficient of expansion. The light weight material reduces the inertial forces set in the engine due to the greater speed at which the piston may be operated. The skirt section is constructed of a metal having a lower coefficient expansion such as cast iron. The lower coefficient of expansion of the skirt section will maintain the operating tolerances more accurately than an alloy of aluminum which would expand due to differential temperatures set up within the piston when the engine is in operation.

Referring to FIG. 3, the crown section 1 is received within the skirt section 2. Two annular tapered rings 31 and 32 are seated within the skirt section 2. A seating washer 33 is positioned immediately above the tapered ring 32 which engages the lower end of the crown section 1. The lower tapered ring 32 engages a locking ring 34 which is held in position by the lock washer 35 received within the annular groove 36 of the skirt section 2. A resilient expansion ring 37 having a surface mating the tapered surfaces of rings 31 and 32 is seated to radially expand against the inner portions of the rings 31 and 32 which causes an axial pressing of the rings to seat the crown section 1 firmly against the radial flange 50 under portion of the shoulder 26. This construction permits thermal expansion axially of the crown relative to the skirt section and yet maintains their position relative to each other.

The crown section 1 is also constructed in a manner whereby the skirt section 2 includes a reinforcement rib 38 to maintain its peripheral dimension. The crown section has a thin walled cone-shaped combustion chamber which permits axial expansion in preference to radial expansion accompanied with slight deformation due to the constraining forces of the skirt section 2 and the cooling of the adjacent walls at crown section. This construction provides a means for maintaining peripheral dimension of the skirt section and the tolerances between the piston and the cylinder walls.

The passage 23 is connected to the oil groove 24 and the intermediate groove 22 which is connected to radial passages 51 as shown in FIG. 5. These passages provide drainage of any oil which may enter the oil ring groove 2.

A longitudinal groove 52 in the crown section has been described and illustrated and its operation will be more specifically set forth in the following paragraphs.

The connecting rod 6 is connected to a suitable crankshaft in an internal combustion engine. The engine is designed to operate with forced oil lubrication of the bearings. An adequate supply of lubricating fluid is supplied through passages in the crankshaft which in turn are in communication with the longitudinal passage 9 in the connecting rod 6. Pressurized fluid passes through the passage 9 into the peripheral passage 11 and the radial passages 10 and the transverse bore 12 at the wrist pin 7. The pressurized fluid then passes upwardly through the passages 15 and the radial passages 16 which are in communication with the lower end of the helical grooves 17. The helical grooves 17 are formed in the outer periphery of the crown section 1 to maintain cool operating temperatures. The helical grooves 17 are in communication with the annular groove 18. The annular groove 18 also is connected to the radially inwardly formed passages 19 through which the lubricating fluid is then vented. The fluid is caused to flow within the bell-shaped chamber 21 and the crown section to cool the walls in the inner periphery of the crown section 1. To a limited extent the cooling is similar to the "cocktail shaker" type piston and also the oil is permitted to fall directly on the wrist pin bearing which provides the cooling of the bearing assembly. The oil is then permitted to flow away from the piston and return to the oil supply. A suitable cooling means or heat exchanger is provided for the oil recirculated through the piston. The cooling of the oil will maintain the oil and the piston at a lower operating temperature to prevent mechanical failure.

The preferred embodiment of this invention have been illustrated and described and the scope of this invention is defined by the attached claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A two-piece piston for use in an internal combustion engine comprising, a crown section defining a wall forming a part of the combustion chamber, a hollow wrist pin fastened to said crown section adapted for connection to a source of pressurized fluid, a skirt section having rings on a portion of its outer periphery receiving said crown section, means fastening said crown section to said skirt section, connecting passage means connecting said hollow wrist pin and extending upwardly adjacent the adjoining walls of said sections, cooling passage means extending peripherally about said crown section upwardly to a point adjacent the walls forming said combustion chamber for cooling the ring portion of the piston, and passage means extending radially inwardly to vent the oil about the wrist pin to thereby provide cooling of said piston.

2. A two-piece piston for use in an internal combustion engine comprising a crown section constructed of a light weight metal having a high coefficient thermal conduction defining a wall forming the combustion chamber, a skirt section receiving said crown section constructed of a heavier metal having a low coefficient of expansion, a hollow wrist pin received in said crown section and extending transversely in said crown section adapted for connection to a source of opening means connected to the lower end of said skirt section and resiliently biasing said crown section to an upwardly fixed position relative to said skirt section, means defining annular passages connected to the bore of said hollow wrist pin and formed between adjoining walls of said crown section and skirt section, helical passage means formed on the outer periphery of said crown section connected to said annular passage formed between said crown section and said skirt section, for cooling the peripheral walls at said piston, passage means for conveying fluid from the upper end of said helical grooves internally within said crown section to thereby provide a means of conveying fluid for cooling said wrist pin and dissipating heat from the peripheral walls of said piston.

3. A two-piece piston for use in an internal combustion engine as set forth in claim 1 wherein said crown section defines a central opening said oil supply pin in communication with said cooling passage means.

4. A two-piece piston for use in an internal combustion engine as set forth in claim 3 comprising means defining an oil groove on said skirt section and drain passage means from the oil ring groove on the external periphery of said skirt section to said opening, sealing means on the peripheral surface of said crown section sealing said
drainage passage means the cooling passage means on the peripheral surface between adjoining walls of said crown section and said skirt section.

5. A two-piece piston for use in an internal combustion engine as set forth in claim 1 comprising a cone shaped wall for forming a portion of the combustion chamber to permit axial expansion because of the skirt section receiving said crown section to thereby control operating tolerance of said piston.

6. A two-piece piston for use an internal combustion engine as set forth in claim 1 comprising a resilient fastening means including a radially expanding tapered ring expanding against mating tapered rings to resiliently bias the crown sections in locked position with the skirt section and allow axial expansion in preference to radial expansion to said crown section.

7. A two-piece piston for use in an internal combustion engine as set forth in claim 3 comprising a skirt section having an oil ring groove on the outer periphery of said skirt section, means defining drain passages intermediate said oil groove and said central opening in said crown section to permit drainage from said oil ring groove, sealing means on the outer periphery of said crown section intermediate said crown and skirt sections immediately above and below said drainage passage to seal said cooling passages in said piston from the drainage passages.

References Cited

UNITED STATES PATENTS

1,305,567 6/1919 Ritter 123—41.37
1,306,839 6/1919 Schneider 92—186
1,557,871 10/1925 Painter 92—186
1,773,372 8/1930 Nelson 92—216 X
1,938,826 12/1933 Frank 92—215
2,742,883 4/1956 Smith 92—186
2,807,247 9/1957 Cramer 123—41.38
2,818,841 1/1958 Nichols 123—41.35
3,187,643 6/1965 Pope 92—216 X
3,215,130 11/1965 Maier 123—41.35

FOREIGN PATENTS

279,056 2/1952 Switzerland.

AL LAWRENCE SMITH, Primary Examiner.

U.S. Cl. X.R.

92—186, 215, 216, 224